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Preliminary results of the Lesser Snow Goose collaring program on the Alaksen National Wildlife Area, 1986 and 1987

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Abstract

A joint program between the Canadian Wildlife Service and the Washington Department of Wildlife to collar Lesser Snow Geese (*Anser caerulescens caerulescens*) on the Fraser River delta, British Columbia, was initiated in the fall of 1986. Birds were captured on fields on the Alaksen National Wildlife Area using rocket nets. Neckbands were placed on 396 birds in November 1986 and on 298 birds in December 1987. Of those collared in 1986, 367 were resighted that winter and 197 the following winter. Of those collared in 1987, 286 have been resighted. Most resightings (>90%) were from the Fraser River delta and the deltas of the Skagit–Stillaguamish rivers in Washington. Only six winter sightings have been made in other locations. The deltas of the Fraser and Skagit–Stillaguamish rivers thus constitute a discrete wintering ground for snow geese in the Pacific flyway. In the summer of 1987, 47 collars were sighted on Wrangel Island, USSR, at 29 different nests and among nonbreeders. There was no indication that a discrete part of the colony was being used by geese banded on the Fraser River. The only problem noted so far with the collars is an apparently high rate of loss, based on sightings of legbanded but uncollared birds.

Introduction

In 1986, a Lesser Snow Goose (*Anser caerulescens caerulescens*) collaring program was initiated on the Alaksen National Wildlife Area in cooperation with the Washington Department of Wildlife. The prime objective was to determine whether there was an interchange of geese between the Fraser River delta in British Columbia and the deltas of the Skagit–Stillaguamish rivers in Washington. The timing and nature of the project fitted well with the terms of reference of two other major undertakings. One was a preliminary report to the Arctic Goose Joint Venture committee recommending a major banding effort on white geese throughout the Arctic, to reassess migration and distribution patterns. The other was a Canadian Wildlife Service (CWS) study designed to measure the impact on the habitat of the rapidly expanding snow goose population wintering on the Fraser River delta (Boyd 1988). Our purpose in this paper is to record some of the preliminary results of the collaring program as they pertain to continental management of the geese. We present information on capture of the geese, numbers banded, numbers and locations of resightings, fate of collared birds, and associated work on the nesting grounds on Wrangel Island, USSR.

Background

Lesser Snow Geese nesting on Wrangel Island in Siberia winter in two major areas in western North America. One component (about 55% of the population; VVB, unpubl. data) migrates to several areas in California via an as yet unconfirmed route (Syroechkovskiy and Litvin 1986). The remainder migrates along the coast of Alaska and British Columbia to the deltas of the Fraser River in British Columbia and the Skagit–Stillaguamish rivers in Washington.

Geese usually begin arriving on the Fraser River delta in late September, with the peak of migration occurring in mid-October. They remain in largest numbers on the Fraser River delta until early January, when almost all move into Washington. Although weather and food availability may play a role, the midwinter exodus from the Fraser River delta of the final few thousand lingering geese is most likely prompted by the hunting pressure caused by the opening of the second half of the BC hunting season. In the second winter of this study, hunting was permitted from 10 October to 30 November 1987 and 16 January to 10 March 1988 in British Columbia, and 17 October 1987 to 1 January 1988 in Washington.

The number of geese in the Wrangel Island population declined sharply during the 1970s, to a low of approximately 45 000 in 1975 (Bousfield and Syroechkovskiy 1985). At the same time, the numbers wintering on the Fraser River delta were also low: between 1966 and 1974, the highest monthly average, based on aerial estimates, was 6000 geese (McKelvey *et al.* 1985). Since then, the Wrangel Island population has increased, to about 140 000 in the fall of 1987; the highest monthly average on the Fraser River delta was 35 000 in November 1987, based on aerial photo counts (W.S. Boyd, pers. commun.).

Concomitant with the recent increase in population has been a change in habitat use on the Fraser River delta. More birds now tend to remain on the Fraser River delta for a longer period, rather than moving south to the Skagit and Stillaguamish rivers area, and large numbers now feed on the agricultural uplands. Although the Fraser–Skagit flock has traditionally made use of farm fields in the Skagit River area (Jeffrey and Kaiser 1979), it began to do so on the Fraser River delta only during the winter of 1981, which was a cold, snowy season (J.P. Hatfield, unpubl. data).

Study area

The Alasken National Wildlife Area is situated on the northwest corner of Westham Island (49°0′N, 123°10′W) on the main arm of the Fraser River. It consists of 250 ha of upland and is adjoined by the George C. Reifel Migratory

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Bird Sanctuary, which protects an additional 280 ha of foreshore. The uplands of the Alaksen National Wildlife Area are primarily a mixture of farm fields (75%), wet areas (sloughs and ditches 15%), woodland (5%), and developed areas (5%). The farm fields are maintained through a sharecrop procedure, intended to enhance the provision of winter foods for waterfowl, primarily American Wigeon (*Anas americana*) and Lesser Snow Geese. About 25% of the fields are currently maintained as pasture, and the rest are either planted to fall rye after the sharecrops are removed or flooded. In 1986–87, approximately 312 000 use-days for snow geese and 218 000 use-days for ducks were provided in this fashion.

Methods

Snow geese were captured under rocket nets. In 1986, the nets were set along the edges of a pasture field that had been grazed heavily by geese the year before. Attempts were made to make the field as attractive as possible to the geese to encourage them to concentrate near the nets. During the growing season, the field had been maintained by grazing with horses. Once the horses were removed (early September), an area in front of the planned position of the nets was mown, fertilized (35–0–0), and seeded with barley. The intention was to provide a nutrient-high strip of pasture in a part of the field that had received heavy use by geese the previous winter. The geese were further encouraged to use the chosen field by the use of snow goose decoys (both shell and silhouette) and a tape-recorded call of snow geese feeding. About three days prior to the capture, geese began to use the target field. A noticeable quantity of barley was placed in a strip in front of the rocket nets two days before the capture. On the day of the capture, geese settled onto the field just after first light at 06:30. They began to feed intensively and had moved to within range of the nets by 08:30, when they were captured.

Once captured, the geese were transported to a covered, partitioned holding facility adjacent to one of the barns on the Alaksen National Wildlife Area. Birds caught under the same net were kept together in the holding facility and reunited in the release facility. The intention was to keep family groups together as much as possible. Birds were taken from the holding facility and aged, sexed, and leg- and neckbanded. A subset was weighed and measured. Birds were let go from the release pen in groups of about 75. Details of the numbers caught are shown in Table 1. The neckbands were brown plastic with white alphanumeric codes written vertically.

In 1987, we used the same preparations to lure geese to the field used in 1986. However, the geese did not respond, and it was necessary to move the nets to fields already in use. This action resulted in the capture of about 300 geese late in the afternoon of the same day the nets were set out. The same holding facility was used as in 1986. All birds were aged, sexed, legbanded, and collared, and most were weighed and measured (Table 1, Appendix 1). The release was made in the dark from portable transport crates on to an adjacent slough.

Table 1
Numbers, ages, and sexes of snow geese captured on the Alaksen National Wildlife Area in 1986 and 1987

Date	No. of adults (f:m)	No. of immatures (f:m)	Total
5 November 1986			
Collared	94:77	105:120	396
Legbanded only	1:2	1:5	9
3 December 1987			
Collared	99:76	68:55	298
Legbanded only	–	–	–

Results

Resightings

Resighting rates have been high, owing to the limited areas used by the geese, the accessibility of those areas to observers, and the great philopatry of the geese. Of the 396 birds banded in 1986 (171 adults and 225 immatures), 367 (165 adults and 202 immatures) were resighted at least once in the British Columbia and Washington area, and 347 (157 adults and 190 immatures) were resighted more than once that winter (1986–87). During the 1987–88 winter, 197 (99 adults and 98 immatures) of the 1986-collared geese were resighted. Of the 298 birds banded in 1987 (175 adults and 123 immatures), 286 (168 adults and 118 immatures) were resighted at least once, and 279 (163 adults and 116 immatures) were seen more than once that winter.

Movement between the Skagit and Fraser river areas

During the 1986–87 winter, 250 collars were sighted on the deltas of both the Fraser River and the Skagit–Stillaguamish rivers (Table 2). In 1987–88, 136 of the birds banded in 1986 and 240 of the birds banded in 1987 were seen in both areas (Tables 2 and 3). There can be no question, therefore, that

Table 2
Number and location of collared snow geese resighted after banding on the Alaksen National Wildlife Area on 5 November 1986

Location	No. of adults (f:m)	No. of immatures (f:m)	Total
1986–87			
Fraser River delta	84:74	94:102	354
Skagit–Stillaguamish river deltas	65:55	66:77	263
Both areas	62:51	64:73	250
California/Oregon	2[a]:1	0:1[a]	4
Alaska	12:7	7:2	28
All areas	89:75	96:107	371
Summer 1987			
Wrangel Island	21:19	3:3	46
1987–88			
Fraser River delta	47:42	43:51	183
Skagit–Stillaguamish river deltas	49:30	31:40	150
Both areas	41:28	29:38	136
California	1:1[b]	1:1[c]	4
Alaska	6:4	1:2	13
Saskatchewan	1:0	0:1[c]	2
All areas	57:45	47:54	203

[a]One bird shot.
[b]Same bird as in 1986–87.
[c]Same bird in both locations.

Table 3
Number and location of collared snow geese resighted after banding on the Alaksen National Wildlife Area on 3 December 1987

Location	No. of adults (f:m)	No. of immatures (f:m)	Total
1987–88			
Fraser River delta	95:72	64:52	283
Skagit–Stillaguamish river deltas	87:64	55:36	242
Both areas	87:64	54:36	241
California/Oregon	2:0	0:0	2
Alaska	4:4	1:0	9
All areas	97:72	64:52	286

most of the geese use both major deltaic areas as part of a single wintering ground. It can be further stated that this is a true wintering ground and not, at least for the majority, a stopping-off or staging area. This conclusion is supported by the observation of collared birds throughout the winters on both deltas and the very few sightings south of Washington in those same winters (Table 2). These deltas represent the northernmost wintering area for this species.

Disappearance of collared geese

One year after collaring, only half the geese collared in 1986 were reencountered (Table 2). For the Wrangel Island population, rates of mortality in the nonnesting period have been estimated at 5–9% for adults and 20–60% for immatures (Syroechkovskiy and Kretchmar 1981; Bousfield and Syroechkovskiy 1985). The apparently higher rate of attrition among collared birds could be the result of dispersal of marked birds to other wintering areas, higher mortality rates for collared geese, or significant loss of collars.

The least likely reason appears to be dispersal. Only eight birds in two seasons have been spotted or shot outside the northern wintering area, despite intensive observations throughout western North America (Kerbes 1988). Higher mortality of collared geese could be important. To date, 40 of the geese collared in 1986 are known to have been shot between November 1986 and mid-March 1988 (Table 4). The nine adults included in this group represent a 5.3% mortality rate, which is about that expected (Syroechkovskiy and Kretchmar 1981; Bousfield and Syroechkovskiy 1985). The mortality rate of 17.8% for immatures is just below the low end of the range expected for this group. No doubt more geese have been shot and not reported, although it seems unlikely that all the missing geese (208) would fit into this category. Based on a lack of resightings, only 176 of these birds can be considered definitely to have disappeared from the population. If they are all dead, the report rate from hunters (40/176 = 0.227) has been only about one bird in five, but such a rate is plausible. The proportion of adults to immatures in this "disappeared" group (63 adults:113 immatures) is quite different from that expected if the proportions of adults and immatures in the known dead group (9:31) are applied to the missing birds. The expected ratio would be 40 adults:136 immatures. In either case, adult mortality appears to have been much higher than expected (35.8%, 22.5%). Similar results were obtained from birds banded in 1987, except that fewer immature birds were reported dead (Table 5). That difference was probably the result of better survival, because the banding occurred after the end of the first hunting season in British Columbia. In any event, these rates indicate increased mortality in collared adults, a high proportion of subadults in the "adult" group, or error in the assumption that "disappeared" equals "dead."

Table 4
Fate, after two winters, of snow geese collared on the Alaksen National Wildlife Area on 5 November 1986

Fate	No. of adults (f:m)	No. of immatures (f:m)	Total
Known dead	4:5	14:17	40
Collar lost	2:3	2:0	7
Alive	47:30	28:36	141
Disappeared	32:31	56:57	176[a]

[a]Status of an additional 32 is uncertain. All were resighted in 1987–88 but none after the close of the BC hunting season.

Table 5
Fate, after one winter, of snow geese collared on the Alaksen National Wildlife Area on 3 December 1987

Fate	No. of adults (f:m)	No. of immatures (f:m)	Total
Known dead	1:3	4:4	12
Known alive	83:58	49:36	226
Uncertain	15:15	15:15	60

The extent of collar loss can only be inferred at present. Seven geese (five adults and two immatures) that are known to have lost their collars have been encountered. The five adults represent 16.7% of the "disappeared" adults whose fate is uncertain. This percentage is very nearly equal to the difference between observed and expected percentages of "disappeared" adults (13.1%) noted above. Thus, both collar loss and mortality could be important factors, at least for the adults. Although the actual numbers are too small to be useful in calculating the possible fate of the "disappeared" geese, the high percentage does suggest that collar loss may indeed be a problem. Other data supporting this possibility will be discussed later.

The probability of accurately determining the rates of collar loss and mortality on the wintering grounds seems low. Only rarely can more than a very small sample of goose tags be seen at any one time; loss rates may not be constant over time; legbands are hard to spot; adults and immatures have different survival rates; and only a very small proportion of the flock was collared (less than 1%).

Associated work on Wrangel Island

Of the 396 geese collared on the Fraser River delta in 1986, only 47 were sighted on the Wrangel Island nesting colony the following summer (Table 6). The total number of collared birds seen on Wrangel Island is surprisingly low, particularly

Table 6
Sightings on the Wrangel Island nesting colony in summer of 1987 of snow geese collared on the Alaksen National Wildlife Area in November 1986

Location	No. of adults (f:m)	No. of nests represented	No. of immatures (f:m)
Wrangel Island, 1987			
Sighted	17:25	–	2:3
At nest	16:18	29	1:2
Fraser River delta, winter 1987–88			
Nests sighted	15:22	–	2:3
With offspring	6:6	9	–
With offspring (not seen nesting)	6:5	7	1:2

in light of the large number of adults (151) resighted on the Fraser–Skagit wintering area. Of the 47 collars seen, 34 were adults sighted at 29 different nests scattered throughout the colony. The remaining 13 were either immatures or adults not associated with a nest. There was no indication that a discrete part of the colony was being used. However, because the collared geese represent less than 1% of the geese wintering in the Fraser–Skagit rivers area, lack of concentration of brown-collared nesters does not necessarily mean that this wintering population mixes completely with the "California" geese.

Of the 34 collared adults seen nesting, all were accounted for subsequently. Only three were not observed in the Fraser–Skagit area: one (f) was shot early in the autumn on the Fraser River delta, and two others (1m:1f) were sighted in California.

There are several possible reasons why so few collars were encountered on Wrangel Island. Collars may have been lost, some collared birds may not have nested, some may have nested away from the main colony, or some may simply have been overlooked. Nine pairs known to have had both members collared during 1986–87 were seen on Wrangel Island in 1987 with only one partner wearing a collar. Three of the original partners are known to have been shot prior to the nesting season; hence, their uncollared partners at the 1987 nests must have been new mates. At least three of the nine uncollared mates were wearing legbands (one seen on Wrangel Island, two seen later on the Fraser River in 1987–88), meaning they had lost their collars. These observations further imply that collar loss may be significant.

Only 55% of the adult geese returning to Wrangel Island in 1987 nested. Therefore, almost 75% of the collared birds (some adults and all the immatures) would not have been at a nest. Those birds were most likely in the highly elusive flocks of failed breeders and nonbreeders and therefore would not have been identified.

Only 31% (nine pairs) of the collared geese seen nesting on Wrangel Island in the summer of 1987 were resighted with families the following winter. Such a finding is hardly surprising in light of the typically high nest and brood losses that occur on the island (Bousfield and Syroechkovskiy 1985). However, it is surprising that although an additional seven collared families were sighted in the winter, the collared adults had not been encountered nesting. If the same level of production loss applies to the "unsighted" as to the encountered nesters, then perhaps 22 nests with at least one collared adult were not detected. It is possible those birds may have nested in small colonies formed around Snowy Owl (*Nyctea scandiaca*) nests elsewhere on the island or on the Soviet mainland. These possibilities will be investigated in the future.

Discussion and recommendations

Our original objective of determining the relationship between the geese using the Fraser River delta in British Columbia and those using the deltas of the Skagit and Stillaguamish rivers in Washington has been met. Those flocks form a single wintering population. We can now examine the relationships in finer detail and answer such questions as the following:
(1) Do geese fly back and forth between the two areas throughout the winter?
(2) What factors trigger mass movements from one area to the other?
(3) Are there geese that use only one of the estuaries, to the virtual exclusion of the other, and are these the same individuals each year?
(4) Are there geese that can be classified predominantly as "field-users," and others as "foreshore-flat-users"?
(5) Are the flocks using the Skagit River delta discrete from those using the Stillaguamish River delta?
(6) What factors distinguish each delta from the others?
(7) Do offspring exhibit the same patterns of winter habitat use as their parents?

In August 1988, 902 of 1400 snow geese legbanded by Soviet researchers on Wrangel Island were also marked with red neckbands. Those marked birds should aid both in the present projects on the wintering grounds as well as in the determination of the migration route(s) of those Wrangel Island snow geese that overwinter in California and surrounding areas. This latter question may be quite important, because the population may use two of the North American flyways—Pacific and Central (Syroechkovskiy and Litvin 1986). Such differential migration could have interesting management implications.

The possibility of high collar loss requires further investigation. Should collar loss be confirmed as a major problem, the testing of new collars or novel marking techniques would be warranted.

The negative effects of the collars on the birds appear negligible. Only two of 694 birds collared are known to have caught their lower mandible in the collar, been unable to free themselves, and subsequently died. The very high resighting rate precludes many other deaths due to collars. Icing of collars, a rare but occasionally severe problem for Canada Geese (*Branta canadensis*) on fresh water in colder parts of the country, has not been a problem, nor is it likely to be. Snow geese encounter very different environmental conditions and may also behave differently from Canada Geese. We have also not been able to detect an abnormally high level of preening behaviour involving the collar, other than during the first day or two after application. We have observed, on Wrangel Island and on the wintering grounds, many geese that were fitted with collars during a marking program in the mid-1970s and that appear healthy and have raised numerous broods since their collars were put on.

Although we conclude that neckbanding has no major effect on reproductive efficiency of the snow geese, our data are still too meagre to conclude that there is no effect (cf. Ankney 1975, but note that both the material and dimensions of those collars were different from the ones we have used). We therefore recommend caution in the use of our data for population modeling because of the need for accurate, unbiased data in such exercises (Owen 1982; Gauvin and Reed 1987). Our observations suggest that neckbands are ideal for the study of patterns of migration and habitat use, and of family relationships, in Lesser Snow Geese. Resightings of geese marked only with legbands are nearly all hunter returns, i.e., a single and final data point for that bird. In marsh and long field vegetation, as well as on the water, legbands simply cannot be spotted. Collars also enable identification at relatively great distances, thus causing minimal disturbance to the geese. With intensive resighting efforts, collars can provide a greater amount of more detailed information than equivalent numbers of legbands. However, because it has not yet been conclusively shown that these neckbands are completely harmless to the snow geese, we recommend collaring only when:

(1) the collaring will provide information of considerable importance for the management of the geese;

(2) other traditional marking methods would be inadequate; and

(3) the collaring will be followed up with intensive efforts for resighting.

We recommend continued marking of Lesser Snow Geese on the Fraser River delta and on Wrangel Island, as well as intensive monitoring on Wrangel Island, on the Fraser–Skagit–Stillaguamish river deltas, in California, and along possible migratory corridors in Alaska, Yukon, western Northwest Territories, Alberta, Saskatchewan, Montana, and Idaho.

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Appendix 1

Mean weights and culmen lengths of snow geese collared on the Alaksen National Wildlife Area in 1986 and 1987

	Weight (g)		Culmen length (mm)	
Year	$\bar{x}$ ± SD	*n*	$\bar{x}$ ± SD	*n*
1986				
Adults	2357 ± 237	105	56 ± 3	87
—male	2466 ± 240	43	57 ± 3	35
—female	2273 ± 202	59	55 ± 3	50
Immatures	2012 ± 208	129	56 ± 2	8
—male	2094 ± 206	62	56 ± 2	7
—female	1936 ± 179	67	59	1
1987				
Adults	2333 ± 222	176	55 ± 3	142
—male	2481 ± 170	75	56 ± 2	56
—female	2220 ± 189	100	54 ± 3	85
Immatures	2032 ± 170	122	54 ± 3	94
—male	2088 ± 165	54	55 ± 3	41
—female	1987 ± 161	68	53 ± 2	53